characteristics of railway motors, upon the design of which Mr. Hobart is an acknowledged authority. Throughout the whole of this section a liberal use is made of graphical methods, and a number of curves referring to the energy consumption under different conditions in actual practice is given.

Chapter v. deals with the generating plant, and is, in our opinion, so far as the practical value of the information contained is concerned, scarcely so useful as the rest of the book; considerable space is devoted to descriptions of tramway generating stations, which, however up to date at the time of construction, are hardly representative of the most modern practice. The question of power-station design is a subject of its own, and is not one upon which the railway engineer, pure and simple, is often called upon to express an opinion. A design is given, however, of a proposed 10,000-kilowatt station, but, so far as can be judged from the drawing, the "complete unit" system by which, for safety reasons, the plant and buildings are entirely subdivided does not appear to be recommended. Interesting tables of the comparative cost and annual over-all efficiencies of various generating stations are given.

A chapter upon the transmission of the electrical energy calls for no particular comment; sections of the cables adopted on various railway systems and the sizes of such cables are given. Particulars are also given of the cost of these cables, but the value of this is, of course, greatly dependent upon the price of copper. Substations are next dealt with, details being given of a very large number of actual substations used in railway work.

Chapter viii., dealing with the distributing system, in other words the third rail, is of more interest, and contains a number of tables dealing with recent practice in this connection; overhead work is also illustrated, though not so fully as could be wished.

Part iii. deals with rolling-stock, and is replete with illustrations and working drawings of locomotives and carriages. This portion of the book, however, shows signs of haste in editing, and in future editions we would suggest that the efficiency curves of motors which it contains, and, in fact, the reference to motors generally, should be gathered together in one section, namely, chapter iv., where most of them are already to be found, instead of being again dealt with under locomotives; certain of the data of rolling-stock given in chapter iv. would, in our opinion, be more easily found in the chapter which is specially devoted to that branch.

These are, however, minor criticisms. The work is one of great practical value to all railway engineers, and will be further enhanced if in future editions more actual illustrations of the total costs of operation of electrified steam railways can be furnished. The North-Eastern Railway, the Lancashire and Yorkshire, and the District Railways have all been in operation long enough to furnish data of the greatest commercial value.

The general "get up" of the work is excellent, as are the reproductions of the various drawings.

OUR BOOK SHELF.

L'Année technique, 1906. By A. Da Cunha. Pp. xii+237; illustrated. (Paris: Gauthier-Villars, 1906.) Price 3.50 francs.

SINCE 1901 the author has each year prepared in attractive form a concise summary of recent progress in engineering, and his series of volumes cannot fail to prove of inestimable value to the student of French industrial history. His annual summary is not a mere compilation of disconnected notes, but a collection of essays written with originality, technical knowledge, and literary skill.

The subjects dealt with in the record for 1906 comprise accidents in works, the heating and water-supply of houses, public works, and locomotion. A museum illustrating the prevention of accidents in works having recently been inaugurated at the Conservatoire National des Arts et Métiers, Paris, the author has seized the opportunity of dealing at some length with the subject of industrial hygiene, and describes the museums that have been established with the object of bringing to public notice the arrangements that have been found by experience adapted for the protection of workmen in various industries. Museums of this kind exist at Zurich, Amsterdam, Vienna, Munich, Berlin, and Paris. The problem of efficaciously heating dwelling-houses is one that has long been under consideration. The old French fireplace, in which, it has been said, the hottest place is at the roof, has been superseded by modern fireplaces, by fixed or movable stoves, and by heating with steam or hot water.

Many ingenious improvements are described by the author, who also gives some useful advice on this important topic. Other interesting subjects dealt with include the installation of the huge compressed-air caissons for the passage of the Paris Metropolitan Railway under the Seine, the recent developments in automobile transport, and locomotion on ice and snow. The numerous illustrations have been carefully chosen and well executed, and the volume is produced in an attractive style at a modest price. Mr. Alfred Picard contributes a preface, which, like the rest of the volume, may be studied with profit and pleasure, not only by the engineer, but also by the general reader desirous of acquainting himself with the events of the day.

Diseases of Fruit and Fruit-bearing Plants. (Board of Agriculture and Fisheries.) Seven diagrams and text. (London: Printed for H.M. Stationery Office by Darling and Son.)

THE Board of Agriculture and Fisheries has issued a series of seven small coloured diagrams illustrative of a number of common diseases met with in cultivated plants, especially those which are grown for the sake of their fruit. They are adapted for use in schools in the country districts. They illustrate the general appearance of the diseased fruits, without any botanical details. Indications are given as to the best methods of prevention. The use of Bordeaux mixture is frequently and judiciously recommended, but no instructions are given as to the way in which the mixture should be prepared. It is certain that, in spite of the publicity which has been given to this excellent fungicide, many cultivators do not yet know how to prepare it. The use of liver of sulphur is also recommended, but the caution is not added that it should not be allowed to come in contact with the paint on frame or greenhouse so as to prevent the discoloration that would otherwise ensue.

No attempt is made to indicate the degree of injury inflicted by various fungi; thus the first of the series, the "strawberry leaf-spot," is of very little conse-

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quence as compared with No. 2, the strawberry mildew. The now famous American gooseberry disease is illustrated. To prevent its spread, the use of one ounce of potassium sulphide dissolved in three gallons of water is recommended. With this solution the bushes should be sprayed just before the leaves expand, and the spraying should be repeated at intervals as necessary. It is unfortunate, we think, that the destruction of affected bushes by fire is not also recommended. A descriptive pamphlet, for which one penny is asked, is supplied with the diagrams.

La Mécanique des Phénomènes fondée sur les Analogies. By M. M. Petrovitch (Belgrade). "Scientia" Phys.-Math. Series, No. 27. Pp. 96. (Paris: Gauthier-Villars, 1906.) Price 2 francs.

DR. J. W. MELLOR, in his "Chemical Statics and Dynamics," p. 19, gives the following as the four stages of a physical theory:—hypothesis, differential equation, integration, observation. While this sequence is well illustrated in the study of dynamical phenomena, these, after all, constitute but a small proportion of the large number of effects in which changes are brought about by the action of definite causes. This book, while not containing any very novel and striking features, puts matters in a somewhat fresh light by giving prominence to the more philosophical aspect of the equations of mathematical physics and allied branches of science. Thus the motions determined by a constant force, a positive, and a negative force varying as the distance, are all characterised by different known forms of the integrals of the equations of motion. If in any phenomenon the changes which occur can be represented by equations of the form of one of these integrals, then conversely the relation between cause and effect may be of the same form as the corresponding law of force. The mathematical portion of the book is comparatively simple, and about the hardest problem considered is that of forced oscillations in a resisting medium. The book appears suitable for placing in the hands of such science students as have not the time to pursue an extended course in mathematics, as they would doubtless get many hints from its perusal. It may be doubted whether much is gained by the inclusion of physiological problems, such as the action of bacteria, in the present discussion, or whether such problems can indeed be adequately treated without introducing statistical considerations. But there are many cases where, even if the analogy be not exact, it is more easy to picture the progress of phenomena by associating them with dynamical or other analogues, and the book will be useful if it teaches students to think in this way.

The Steam-table. A Table of the Thermal and Physical Properties of Saturated Steam Vapor and of the Specific Heat of Water. Compiled from various sources by Prof. Sidney A. Reeve. Pp. ii+42. (New York: The Macmillan Company; (London: Macmillan and Co., Ltd.) Price 1s. 6d. net.

THIS is a very elaborate table from 400 lb. per sq. inch and 445° F. down to 0.18 lb. per sq. inch and 32° F. Usually we know a pressure in round numbers or a temperature in round numbers, and two separate tables are needed; Mr. Reeve's table contains both, and there is an ingenious arrangement for making interpolation easy. There are entries for every degree, and also for every pound per sq. inch. The usual error of such tables, using Regnault's heats with a value of Joule's equivalent which does not agree with Regnault's unit of heat, seems to be avoided by Mr. Reeve, and this steam-table seems to us likely to prove of very great value to steam engineers.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Ionisation by Spraying.

IN a paper published in the *Philosophical Magazine* (February) I noted that positive and negative ions could be observed in large quantities by an Ebert apparatus if fine spray from water were produced profusely in its neighbourhood. Whilst much work has been done in connection with electrification caused by the bubbling of air through water and the splashing of drops, the effects due to spray do not appear to have received much attention.

A description of a simple method of studying the ionisation by spraying, with a preliminary note of some of the results obtained, may therefore be of some interest. A strong current of air, filtered through cotton wool, is passed for a definite time, usually half a minute, through a small glass sprayer, as supplied by Beckmann for introducing salts into a flame for spectroscopic work; but in the present case the air and spray pass together into the large lower chamber of an electroscope containing an insulated cylinder connected with a gold-leaf system in a small upper chamber. The leaf remains steady when air alone is driven into the lower chamber, except for a slight natural leak, which remains constant in spite of much spraying.

When spray has been introduced into the electroscope for half a minute the fall of potential is observed for that time, and from minute to minute until the leaf steadies to the natural leak. The effect terminates in two or three minutes in the case of water, but in the case of acetic acid, chloroform, ether, and the alcohols the ionisation effects do not disappear for ten to fifteen minutes, so that there are large inert ions, both positive and negative, present, some with a velocity of the order 10^{-5} cm./sec. in a field of 1 volt/cm. Similar results have been found by Aselmann for salt solution.

In most cases the positive and negative ions are generated in nearly equal quantities, but with water the negative ions are about 1·5 times as numerous as the positive. The same ratio holds for ether, of which the negative ions are more quickly removed than the positive. The most important point, however, is that small quantities of liquids can be examined by the help of these small sprayers, and definite results obtained for the substances, if care is taken to avoid impurities.

The following is a preliminary statement of the results obtained:—

Substances	Negative	Positive
Mercury	0	0
Toluene	0·02	0·02
Sea-salt and water	0·01	0·015
Hydrochloric acid and water	0·04	0·04
Pentane	0·07	0·03
Phenetol	0·08	0·08
Benzine	0·14	0·08
Ammonia water	0·45	0·30
Tap water	0·65	0·50
Distilled water	1·7	1·0
Ether	3·7	2·5
Chloroform, pure	2·3	2·3
Chloroform, impure	4·5	4·5
Acetic acid	3·2	3·2
Methyl iodide	3·0	3·0
Methyl alcohol	3·0	3·0
Ethyl alcohol	3·5	3·5
Amyl alcohol	4·5	4·5

The figures are taken to an arbitrary standard and are expressed in terms of the positive ionisation due to distilled water. It may be better ultimately to select ethyl alcohol as a standard of comparison, because the ionisation due to water varies sharply when any impurity is introduced.

It is remarkable that volatile substances like benzine, pentane, phenetol, and toluene should give rise to little or no ionisation when sprayed, whilst ether, chloroform, alcohol, and aldehyde should so profusely form both positive and negative ions.

A. S. EVE.

McGill University, March 22.

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